or downhole motor. Any interruption or reduction in the speed of rotation of the bit reduces th nergy imparted for cutting the rock and is contrary to optimal drilling performance. In contra-distinction, Applicant's shearing bit is always driven at least at the rpm of the housing. Further, the bit is periodically rotationally impacted to provide a momentarily increase in power or energy into the drilling that over that otherwise possible.

None of the cited art couples the bit for driving with the apparatus driving the tool.

As set forth simplistically in an attached schematic **SKETCH 1**, of the various technologies, and in a broad overview of the cited art in view of the objectives set forth above, please note that:

- Menton US 3,396,807 provides a two element impact tool which relies on the bit (one element) slowing relative to the drilling string (a second element) so as to actuate its impact mechanism. Torque delivered to the drilled formation causes the bit rotation (rpm) to lag the nominal rotation of the driving drill string before the tool is actuated to impact and thus results in less energy being imparted to the rock.
- Orr US 3,316,986 provides a two element jarring tool which relies on the lower section (one element) being stationary relative to an upper section (a second element such as a drilling string) so as to actuate its 90° or ¼ turn impact mechanism. If adapted to drilling operation, the lower section having a (dotted lines) bit would not rotate until the tool finally actuates during its last ¼ turn and then only for a single instance, resulting in a rotational, torque spike but with virtually no sustained energy being imparted to the rock. Continued drilling operation could not reset the tool for repeated and periodic impacts.
- Hall US 4,694,918, while extolling some advantages of PDC cutters, actually teaches implementation in a percussive bit (up and down action) for crushing rock below the bit and is not relevant to this invention.
- Applicant drives both the housing and a bit. The bit cannot slow relative to the housing. Rather, the bit receives an increase in energy resulting in an increase in torque through the periodic transfer or imparting of the stored potential energy into the bit. As set forth in dependent claims, further benefit is obtained by enabling coupling means between the housing and the bit having limited movement to ensure the energy is concentrated at the bit and not shared between all the components of the bit and housing.

<u>Rejection under 35 USC 102(b) – Anticipation - Menton</u>

Apparatus claims 6-7, 10 are rejected as being anticipated by Menton. Claim 7 is cancelled.

In amended claim 6 the indefiniteness of the rotary drives is corrected and thus now identifies a first rotary drive and a second rotary drive. The second drive periodically imparts energy into the bit for increasing its drilling torque.

Applicant believes that this correction should now assist the Examiner in distinguishing the claimed invention from the cited art.

To further assist the Examiner, Applicant contends that Menton teaches:

- rotating a drill collar 36 to drive a hammer 14;
- a housing supporting a drill bit 16 acts as an anvil 12 and is fit about the hammer 14;
- the anvil 16 and hammer 14 engage face to face with upper and lower tooth-shaped cam surfaces 20,22.
- normal right hand drilling rotation of the collar 36 rotates the hammer 14. Under minimal resistive cutting torque at the bit 16, the weight on the collar maintains the hammer 14 and anvil 12 in co-rotation and no impact results.
- only as the bit 16 and housing anvil 12 slows in rotation relative to the collar 36 and hammer 14, the hammer cam's 20 sloped face 24 climbs up the anvil cam's 22 sloped face 24.
- The slower the bit, including stopped, the faster the hammer 14 climbs the slopes 24.
- When the hammer 14 climbs to the top of the cam's 20,22, dogs 94 on the hammer 14 hit dogs 92 on the anvil 12 imparting a rotational impact and arresting hammer rotation.
- The hammer 14 falls vertically into the trough of the cams 20,22, maximizing vertical impact.

Simplistically, the tool of Menton only operates to provide impact of any sort when the bit slows relative to the driving drill collar. Under slight relative rotation due to minimal drag, Menton will impart little if any rotational impact at all. Menton achieves his objective of imparting maximal vertical impact. Menton's tool only provides his maximal achievable rotational impact when the relative rotation is most disparate; e.g. when the bit approaches stopping. Menton's tool only provides impact when the when the drilling energy is approaching a minimum. Thus Menton's energy available at the bit for drilling diminishes as the rotational speed slows. Menton's rotation impact is provided only after the drilling energy is expended in the slip at the sloped surfaces and a lifting of the tool components in preparation for dropping Menton's hammer.

In contradistinction, claim 6 is clear that Applicant's bit is co-rotated with the first rotary drive, and does not slow, retaining maximum drilling energy. Any rotary impact from the second rotary drive is an energy superimposed over and above the drilling energy already provided by the first rotary drive.

Menton does not teach co-rotation of a first rotary drive, a housing and the bit, nor is Menton capable of providing additional energy into bit.

Menton cannot anticipate Claims 6 or 10 as Menton is deficient the elements as described above.

Rejection under 35 USC 102(b) – Anticipation - Orr

Apparatus claims 6-9,11,13-14,17 and 20 are rejected as being anticipated by Orr.

Orr teaches a rotary jar capable of only a ¼ turn before reverse rotation resets the tool. A lower section is connected to stationary tool and constitutes an anvil 20. The Examiner analogizes the lower section as a bit or being attached to a drill bit. An upper section is attached to a rotary drive such as a drill string resides coaxially in a bore of the lower section. The upper section incorporates a hammer 17. The upper section is rotatable 90 degrees between two positions; a cocked position and an impact position ¼ turn rotated from the cocked position. Torque applied to the upper section builds as the hammer slowly moves through a fluid tight cavity and is finally is released at a final rotation to impact the anvil 20. The upper section must be reversed in rotation to reset the hammer and anvil.

Applicant believes that the Examiner has incorrectly characterized Orr. With respect, Orr does not teach a motor nor the use of drilling fluids to drive same. Orr could be described as having a housing 3 but contrary to the Examiner's assertion, the housing 3 is not adapted to be driven by a rotary drive. The bottom of body 29 is integral with housing 3 once threaded together. In the Examiner's analogy, the "bit shaft" is integral with the housing. The upper section 5 is a mandrel having the capability of only a ¼ turn within the housing. The mandrel is adapted to be driven by a rotary drive.

Contrary to Applicant's tool, if Orr's tool is adapted to drilling operations, it would function only a single time. Orr would require cessation of drilling and a reverse rotation to reset the impact mechanism. In effect, all drilling energy must be terminated to reset the single shot mechanism of Orr. A person of skill in the art would not look to Orr for a solution to maintain high torque and optimize drilling.

Again, in amended claim 6 the indefiniteness of the rotary drives has been corrected and thus now identifies a first rotary drive and a second rotary drive. Thus, Applicant believes that this correction should now assist the Examiner in distinguishing the claimed invention from the cited art.

Orr cannot anticipate Claims 6-8 as Orr does not teach first and second rotary drives nor periodic impact of a rotating bit.

Orr cannot anticipate Claims 9 or 11 as Orr does not use of a motor as a second rotary drive, nor a turbine as a motor.

Orr cannot anticipate Claims 13,14 and 17 as Orr does not teach a housing rotated by a first rotary drive and having a bore with a motor located therein.

Orr cannot anticipate Claim 20 as Orr does not use a motor and thus cannot have drilling fluid delivered thereto.

To be thorough, and to obviate an obviousness analysis, Orr does not provide the missing elements of Menton, nor is there any suggestion of such a combination. Specifically, Menton doesn't teach first and second motors; neither

does Orr. Menton does not teach impacting the bit ahead of the first rotary drive; neith r does Orr. The best either Menton or Orr can do is to momentarily impact their respective bit or lower section to temporarily improve the rotational speed of their first rotary drive, but not to increase the drilling torque and energy above that provided by the primary drilling drive. Neither Menton nor Orr have means to impact a bit with energy other than that provided by the drilling rotation itself.

Rejection under 35 USC 103(a) Obviousness

The Examiner has rejected claims 1-5 as being unpatentable over Menton in view of Hall.

As stated above, while Hall may teach that it is desirable to use PDC, Hall does not provide the elements missing from Menton or Orr for that matter. Further Hall actually teaches implementation in a percussive bit (up and down action) for crushing rock below the bit. A roller bit is disclosed. A percussive roller action is irrelevant to the application of a rotary impact.

Menton does not teach rotation of a bit and periodic impact of the bit to advance the bit head of the first rotary drive; neither does Hall. Menton does not consider the advantage of keeping the rotational energy high and superimposing periodic increases in energy over the nominal rotation; neither does Hall. Hall discusses a percussive roller bit which does not benefit from periodic increases in rotary energy and torque. For the same reasons, a skilled person would not combine Orr and Hall.

In view of the foregoing remarks, reconsideration and allowance of claims 1-6, 8-16, 18-27 now on file is respectfully requested.

Respectfully submitted,

Date: Dec 5/02

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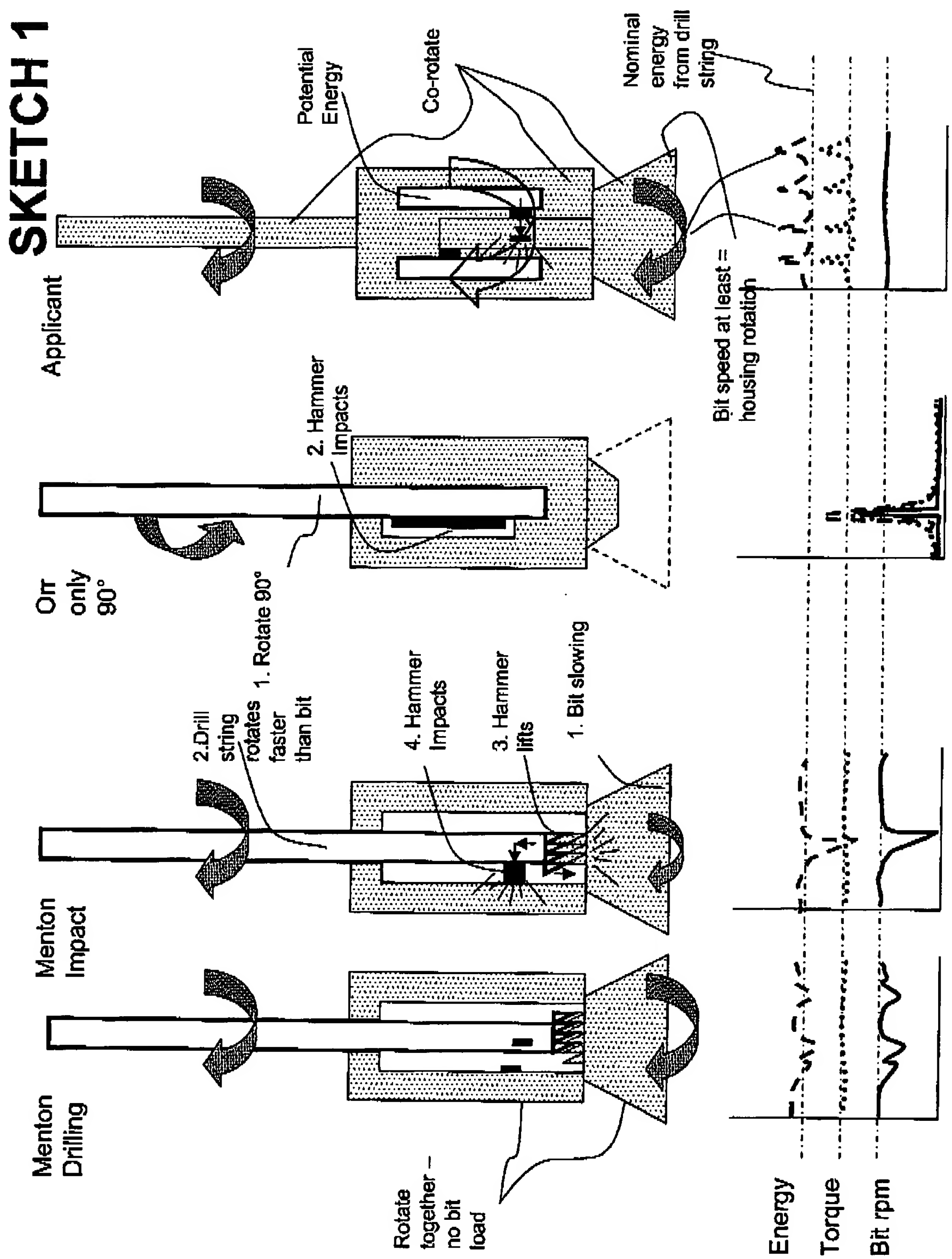
SKETCH 1
Applicant
Orr only 90°
Menton Impact
Menton Drilling
Potential Energy
Co-rotate
Nominal energy from drill string
Bit speed at least = housing rotation
2. Hammer Impacts
1. Rotate 90°
2.Drill string rotates faster than bit
4. Hammer Impacts
3. Hammer lifts
1. Bit slowing
Rotate together – no bit load
Energy
Torque
Bit rpm

**MARKUPS**
**COMPARED TO THE SPECIFICATION AS FILED**

**In the Specification:**

**At page 1, line 4**, the existing paragraph has been amended as follows:

The present invention relates to rotary impact, torque intensifying apparatus for use with drill bits, particularly polycrystalline diamond compact "PDC" bits and methods of use applied to subterranean drilling.

**At page 2, line 7,** the existing paragraph has been amended as follows:

It is an expensive process to trip out and replace ~~and replace~~ a damaged PDC bit.

**In the Claims:**

1. A method for drilling a subterranean formation comprising the steps of:
rotating a ~~PDC~~housing for driving a shearing drill bit~~;~~ at a rotational speed at least equal to a rotational speed of the housing so as to drill the formation;
storing potential energy and
periodically imparting ~~a rotary impact~~the potential energy into the drill bit for increasing drilling torque.

2. The method of claim 1 wherein ~~imparting~~the storing and releasing of the ~~rotary impact~~potential energy comprises the steps of:
rotating an inertial hammer to store potential energy; and
periodically impacting the rotating inertial hammer with a rotary anvil on the drill bit ~~so as~~ to impart the stored potential energy to the drill bit.

3. The method of claim ~~1~~2 wherein the rotary impact is only imparted to the drill bit when the drill bit bears against the formation.

4. A method for drilling a subterranean formation with a PDC drill bit depending from a drill string, the method comprising the steps of:
providing an assembly adjacent the drill bit;
rotating the assembly to rotate the drill bit at a rotational speed at least equal to a rotational speed of the assembly; and
rotating a hammer to store potential energy in the assembly; and
periodically impacting the rotating hammer with an anvil on the drill bit so as to impart the stored potential energy to the drill bit for increasing drilling torque.

6. A rotational impact assembly for a drill bit comprising:

a housing adapted to be rotated by a first rotary drive;

a drill bit extending from th rotating housing ~~and being rotatably driven thereby; and~~

for co-rotation at a rotational speed at least equal to a rotational speed of the housing; and

a second rotary drive located in the housing for periodically and rotatably impacting the drill bit to increase drilling torque.

8. The rotational impact assembly of claim ~~7 wherein the~~6 further comprising a bit shaft through which the drill bit is rotatably driven, the drill bit being adapted for limited ~~rotational freedom~~ rotation relative to the housing so that when rotationally impacted, the bit shaft ~~can rotate slightly and~~ receives the energy substantially independent of the housing ~~rotation~~ whereby the drill bit receives substantially all ~~of~~energy from the rotary impact ~~without engaging the housing~~.

9. The rotational impact assembly of claim 6 wherein the second rotary drive is a motor driven by drilling fluids.

10. The rotational impact assembly of claim 6 wherein the first rotary drive is ~~driven by a~~ rotating end of the drill string.

13. A rotational impact assembly for a drill bit comprising:

a housing adapted to be rotated by a first rotary drive, the housing having a bore;

a motor located in the bore for rotating a stator shaft;

a bit shaft extending from the bore of the housing and being adapted at a downhole end for rotatably driving the drill bit;~~-and~~

means for normally driving the drill bit with the housing at a rotational speed at least equal to a rotational speed of the housing; and

means for periodically coupling the stator shaft and bit shaft for co-rotation whereby rotational energy is transferred from the stator shaft to the bit shaft for increasing drilling torque.

18. The rotational impact assembly of claim ~~17~~14 further comprising:

a carrier driven by the stator shaft for carrying the annular mass about the bit shaft; and

an offset pin in the carrier about which the annular mass can pivot between concentric and eccentric positions about the bit shaft so that upon each rotation of the stator shaft, the carrier and annular mass are rotated concentrically so as to cause the hammer and anvil to couple after which the annular mass pivots to the eccentric position so as to decouple the hammer from the anvil.

20. The rotational impact assembly of claim ~~17~~14 wherein the motor is rotated by drilling fluids flowing to the drilling bit.